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Precision Positional Data of General Aviation Air Traffic in Terminal Airspace

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INTRODUCTION

This document contains brief flight path histories and other reference and derived data of approximately 1200 3-dimensional radar tracks taken at general aviation airports: Salisbury-Wicomico Airport; Montgomery County Airpark; and Hyde Field. The Salisbury-Wicomico Airport is located eight kilometers southeast of Salisbury, Maryland in a relatively low traffic density region. It has three 1600 meter runways which serve private aircraft and commuter traffic to Baltimore, Washington, and Philadelphia. A flight school, air taxi, and an FAA Flight Service Station are available. The Traffic Pattern Altitude (TPA) is designated as 260 meters (800 feet). The Montgomery County Airpark located in Gaithersburg, Maryland, is a very high traffic density general aviation airport. With a single 1400 meter runway, it services corporate, private and sales aircraft, repair and maintenance facilities, and a flight school. The airpark also features left and right hand traffic patterns and a designated TPA of 195 meters (600 feet). Hyde Field is located in Clinton, Maryland and falls within the Washington, DC Terminal Control Area (TCA). Consequently, it exhibits traffic patterns constrained by adjacent airports, the TCA Corridor and the 490 meter (1500 foot) TCA floor overhead. It has two runways less than 900 meters long which are used by private aircraft and a flight school and operates with a TPA of 260 meters (800 feet). These airports were selected because each represented different uncontrolled air traffic situations and each was within 250 kilometers of Wallops Flight Center, thereby facilitating the collection and reduction of data.

Data were collected at each airport for a period of approximately three weeks between October 1971 and March 1972. Date, time, flight number and runway number were logged manually along with such items as pattern type, aircraft type, visibility, cloud condition and wind. Positional histories were obtained automatically using an MPS-19 tracking radar and data van. This equipment recorded on magnetic tape radar slant range, azimuth, and elevation at one second intervals. Table 1 presents selected distributions of data recorded at each airport. These tables present as a function of each airport the distribution by aircraft manufacturer, aircraft type, and pattern type.

The tapes and logs were returned to Wallops Flight Center for further processing. Radar data were edited, smoothed, and differentiated using standard techniques. They were then transformed to a runway relative coordinate system (Figure 1) enabling direct comparison of data regardless of runway used. Logged data were converted to a common format and used to form four identifying headers for each flight. Some reduced positional data were also placed in the headers including maxia and minia, and the start and stop times for each take-off or landing pattern leg. The headers and reduced positional data, presented as a series of detailed records, were then incorporated on an Indexed Sequential Processor (ISP)* language data base, references. The format for the data base may be inferred from the key (see Appendix A).

The data are now available in two media. The data base has been implemented on disc for access through the Wallops Flight Center HW-625 computer. The second media is hard copy. It has been reduced in volume by including only every fifth detailed record. Microfiche records for each radar track in excess of sixty seconds are available on request from NASA. Requests for the supplement should be addressed to:

NASA Scientific and Technical Information Facility
Attn: Distribution and Control
Post Office Box 8757
Baltimore/Washington International Airport,
Maryland 21240

The records are contained on ten (10) microfiche. A printed sample is presented in Appendix B.

*Indexed Sequential Processor, Honeywell Series 600/6000 Software, August 1973.

TABLE I.a. - DISTRIBUTION OF AIRCRAFT MANUFACTURERS

MANUFACTURE*	SBY	GAI	HYD
0	46	97	54
014	2		6
019		2	
042		1	
056	1	1	
063		1	
115	89	53	5
130	1		
138		1	1
207	90	185	292
211	1		6
242	1		
272	1		
302	2		
337			2
395	5	1	
447		2	
458			2
526	1		
587	5	11	9
710	79	83	42
718		1	
722		1	
819		2	
863			2
866	1	1	
885			1
895			1
923		3	1
TOTAL	325	446	424

*Reference U.S. Aircraft Register

TABLE I.b. - DISTRIBUTION OF PATTERN TYPES

PATTERN TYPES	SBY	GAI	HYD
VFR(LEFT) APPROACH	238	167	298
VFR(RIGHT) APPROACH	13	179	1
IFR APPROACH	22	0	0
TOUCH & GO(LEFT)	3	11	30
TOUCH & GO(RIGHT)	0	5	1
DEPARTURE	0	3	20
FLY-BY	37	81	50
UNKNOWN	12	0	24
TOTAL	325	446	424

TABLE I.c. - DISTRIBUTION OF AIRCRAFT TYPES

AIRCRAFT TYPES	SBY	GAI	HYD
SINGLE ENGINE LOW WING	95	140	40
SINGLE ENGINE HIGH WING	92	234	348
TWIN ENGINE LOW WING	109	30	22
TWIN ENGINE HIGH WING	7	12	10
UNKNOWN	22	30	4
TOTAL	325	446	424

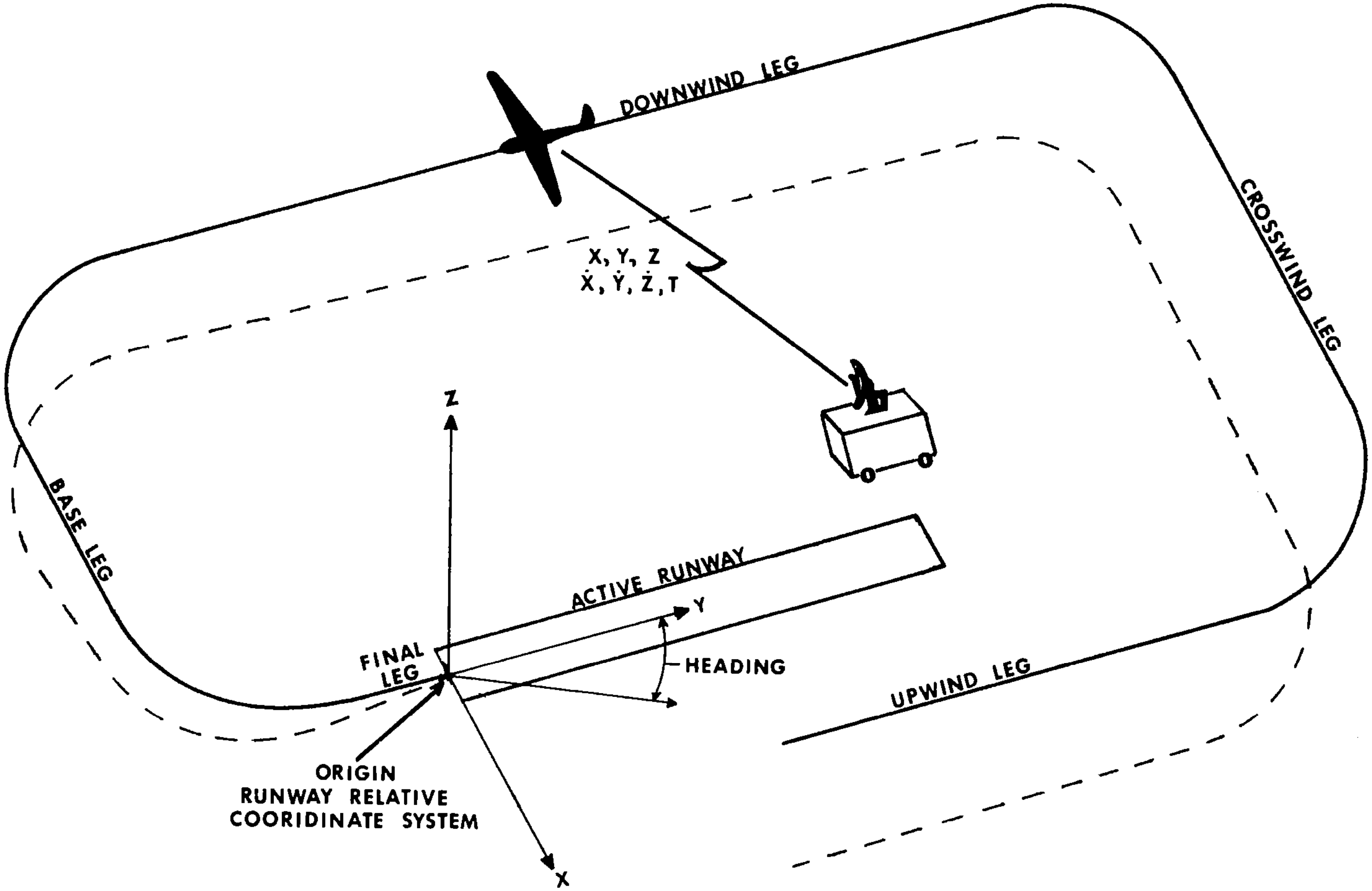

Figure 1. Definition of Runway Relative Coordinate System and Traffic Pattern Legs

APPENDIX A

KEY

1st HEADER

Date - YYMMDD (year, month, day)

Flight No. - Sequential order of track on date indicated

Runway No. - Active runway at time of track

Start Time - EST (Eastern Standard Time)

Aircraft Type - 0 - unknown
1 - single engine, low wing
2 - single engine, high wing
3 - twin engine, low wing
4 - twin engine, high wing
5 - multi-engine

Aircraft Manufacturer - Call numbers from aircraft converted to manufacturer through U.S. Aircraft Register

Aircraft Model - Call numbers from aircraft converted to model through U. S. Aircraft Register

Pattern Type - 0 - unknown
1 - left VFR (visual flight rules)
2 - right VFR
3 - IFR (instrument flight rules)
4 - touch and go, left
5 - touch and go, right
6 - departure
7 -
8 - fly by

*Entry leg - 0 - unknown
1 - upwind
2 - crosswind
3 - downwind
4 - base
5 - final

*Exit leg - 0 - unknown
1 - upwind

2 - crosswind
3 - downwind
4 - base
5 - final

*Entry and exit refer to the legs at which the aircraft entered and left the landing pattern, or to the legs for which data was first or last obtained. An illustration of the various legs is shown in Figure 1.

<u>2nd HEADER</u>

Minimum X
Maximum X
Minimum Y - In runway relative coordinate system (meters)
Maximum Y
Maximum Range - Greatest distance from origin (meters)
Ceiling - (Meters) Values greater than 30,000 imply unlimited ceiling
Sky Condition - cloud conditions
0 - clear
1 - scattered
2 - broken
3 - overcast
Visibility - (Meters)
Ground Wind Velocity - (m/sec)
Ground Wind Direction - (degrees east of magnetic north)

<u>3rd HEADER</u>

Start Time, Upwind Leg
Stop Time, Upwind Leg
Start Time, Crosswind Leg
Stop Time, Crosswind Leg
Start Time, Downwind Leg
Stop Time, Downwind Leg
Start Time, Base Leg
Stop Time, Base Leg
Start Time, Final Leg
Stop Time, Final Leg

NOTE: The start/stop times are given in seconds from the beginning of the track for each leg for which valid data was obtained. Refer to the 1st header for the beginning and ending legs of each track. Refer to Figure 1 for definition of the legs.

4th HEADER

Upper Air (330 meters) Wind Velocity* - (m/sec)

Upper Air (330 meters) Wind Direction* - (degrees east of magnetic north)

*These data are based upon barometric pressure gradients prevailing on the day the track was made. They were calculated by the National Weather Service at Wallops Flight Center.

Detail Records in Runway Relative Coordinate System

Elapsed Time (seconds)

X (meters)

Y (meters)

Z (meters)

X Dot (m/sec)

Y Dot (m/sec)

Z Dot (m/sec)

Bank Angle (degrees) of aircraft assuming coordinated turn.

Heading (degrees) direction aircraft is moving defined positive clockwise from the y axis as shown in Figure 1.

SAMPLE
APPENDIX B

HYD AIRPORT TRACK NO. = 1

DATE	FLIGHT NO.	RUNWAY NO.	START TIME	AIRCRAFT TYPE	AIRCRAFT MANUF.	AIRCRAFT MODEL	PATTERN TYPE	ENTRY LEG	EXIT LEG
720124	1	5	152227	2	207	1812	1	3	5

MINIMUM X (M)	MAXIMUM X (M)	MINIMUM Y (M)	MAXIMUM Y (M)	MAXIMUM RANGE (M)	CEILING (M)	SKY	VISIBILITY (KM)	GRND WIND VEL (M/SEC)	GRND WIND DIR (DEG)
-970.	-16.	-1151.	1548.	1847.	7010.	1.	7.	5.	40.

UPWIND		CROSSWIND		DOWNWIND		BASE		FINAL	
LEG 1 START	LEG 1 STOP	LEG 2 START	LEG 2 STOP	LEG 3 START	LEG 3 STOP	LEG 4 START	LEG 4 STOP	LEG 5 START	LEG 5 STOP
0.	0.	0.	0.	0.	65.	65.	85.	85.	110.

UPPER-AIR WIND VEL (M/SEC)	UPPER-AIR WIND DIR (DEG.)	(WORDS 3 THRU 10 NOT USED)
8.	345.	

SAMPLE

ELAPSED TIME (SEC)	X (M)	Y (M)	Z (M)	XDOT (M/SEC)	YDOT (M/SEC)	ZDOT (M/SEC)	BANK ANGLE (DEG)	HEADING (DEG)
0.	-840.08	1548.39	245.20	-8.03	-18.36	1.97	-5.09	203.61
5.	-895.27	1401.58	255.03	-13.65	-47.61	1.90	-10.06	195.99
10.	-940.81	1163.92	263.56	-5.67	-47.03	1.48	-5.65	186.87
15.	-964.69	922.01	269.31	-3.38	-49.00	0.79	-4.56	183.95
20.	-966.28	680.10	272.78	3.03	-47.83	0.68	-5.78	176.37
25.	-948.97	442.01	274.69	2.42	-46.84	-0.05	1.73	177.04
30.	-926.10	215.24	272.37	3.00	-43.83	-0.82	-0.27	176.08
35.	-925.62	2.48	267.19	1.29	-41.80	-1.18	1.18	178.24
40.	-917.62	-199.50	260.78	2.01	-38.41	-1.42	-1.12	177.01
45.	-906.50	-390.37	252.31	2.53	-39.07	-2.04	-1.14	176.30
50.	-889.05	-586.54	240.31	4.55	-38.82	-2.71	-2.15	173.31
55.	-865.23	-777.63	225.99	4.57	-37.11	-2.92	0.30	172.98
60.	-839.96	-952.57	211.30	6.66	-32.93	-3.02	-7.07	168.56
65.	-781.76	-1093.19	194.77	18.12	-21.28	-3.67	-23.90	139.59
70.	-655.05	-1150.75	175.36	31.76	-1.11	-3.94	-21.89	92.00
75.	-482.45	-1133.14	156.22	35.57	4.05	-3.78	-20.36	83.49
80.	-383.77	-1096.71	137.49	35.71	15.39	-3.61	-20.75	66.69
85.	-143.80	-974.18	121.21	25.62	30.45	-3.02	-19.19	40.07
90.	-57.78	-820.62	105.57	9.66	29.15	-3.34	-11.96	18.32
95.	-30.51	-686.96	87.50	3.04	25.41	-3.59	-2.94	6.81
100.	-18.41	-580.90	70.49	1.67	24.43	-3.34	-2.32	3.92
105.	-17.04	-455.72	54.21	-0.71	28.07	-3.22	-1.45	358.56
110.	-21.24	-290.26	38.23	-1.49	21.54	-3.28	-2.80	356.05

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16. Abstract

Presented are the results of three-dimensional radar tracks of general aviation air traffic at three uncontrolled airports. Contained are data which describe the position-time histories, other derived parameters, and reference data for the approximately 1200 tracks. All information is correlated such that the date, time, flight number, and runway number match the pattern type, aircraft type, wind, visibility and cloud conditions.

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